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REPORT NO. 13

THE JURASSIC SEDIMENTS OF SASKATCHEWAN

by

D. R. FRANCIS

A Preliminary Report

DEPARTMENT OF MINERAL RESOURCES

PETROLEUM & NATURAL GAS BRANCH

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REGINA

1954

PREFACE

This study is not complete, nor does it attempt to answer many of the problems that the geologist will encounter in identifying the various members and units of the Jurassic sediments of Saskatchewan.

However, the work done by Mr. Francis, who has spent a great deal of time on this particular geological section, may be of assistance to the industry. It is then, with this in mind, that the department has published this preliminary report.

The department purposes to have Mr. Francis continue his work on this section with a view to publishing a more complete and detailed study at a later date.

J. T. Cawley (P. Eng)
Director P. & N.G.

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ILLUSTRATIONS

INTRODUCTION

There are no outcrops of rocks of Jurassic age in the Province of Saskatchewan, but their presence in the subsurface has been recognized since the early days of oil exploration. Figure 5 indicates the distribution of Jurassic sediments in the province.

Previous Work

Prior to 1952, reports on the Jurassic sediments of Saskatchewan were limited to scattered references in various publications and to well-completion reports by Imperial Oil Limited.

Dowling, Slipper, and McLearn (1919), Wickenden (1932, 1933, 1935) and Furnival (1946) identified and described the Jurassic strata encountered in some of the wells drilled in Saskatchewan.

During the years 1942-45, Imperial Oil Limited drilled eleven deep test wells in the province which penetrated the Jurassic strata. Lithologic and electrical logs were released for these wells with formation names assigned to the various Jurassic units.

One of the first detailed studies of Jurassic sediments in Saskatchewan was made by Vigrass (1952). He attempted to correlate the Jurassic of the province with some type sections in the northern United States.

In 1952 a committee was appointed by the Saskatchewan Geological Society to study Jurassic nomenclature in the province. This committee proposed a lettering and numbering system of designating the various Jurassic units.

Schmitt (1953) carried out a lithofacies analysis of the marine Jurassic sediments occurring in the northern Rocky Mountains-Great Plains area. Schmitt's report includes the Jurassic formations of Saskatchewan.

Milner and Thomas (1953) have prepared a report on the Jurassic system of Saskatchewan. They have proposed new formation names for the various Jurassic units.

Present Study

In preparing this report, rotary cuttings and cores taken from wells penetrating Jurassic sediments were studied under the binocular microscope and interpreted in conjunction with electrical and radioactive logs. Lithologic characters of formations and members are described in descending order from the top of the sections encountered.

The Rock Color Chart (G.S.A., 1951) was used to designate the color of rocks. The number in parenthesis following a color is the numerical designation of the color in the Rock Color Chart.

Acknowledgments

The writer is indebted to the senior members of the staff of the Department of Mineral Resources for much helpful criticism and advice during the preparation of this report.

The following oil companies and firms consented to release confidential well information:

Bennett and Burns, Consulting Geologists,
The British American Oil Company Ltd.,
Imperial Oil Limited,
Shell Oil Company Ltd.,
Tide Water Associated Oil Co-Operator.

TABLE OF FORMATIONS

SYSTEM	Generalized Stratigraphic Column and Electric Log	SASKATCHEWAN GEOLOGICAL SOCIETY 1952		VIGRASS 1952		MILNER & THOMAS 1953		NOMENCLATURE COMMONLY USED IN SASKATCHEWAN (DERIVED FROM VARIOUS SOURCES) 1949 ~ 1953	
LOWER CRETACEOUS	Overlying Blairmore consisting of interbedded grey shales and sandstone								
JURASSIC	Shale greenish grey, bentonitic non calcareous locally variegated near the top Shale, greenish grey becoming slightly calcareous, in places splintery Sandstone, calcareous with interbeds of greenish grey shale Shale calcareous, splintery, greenish grey locally variegated in the lower part. Interbeds of argillaceous yellowish grey siltstone	J-1	A B C	UPPER SUNDANCE	U-1 U-2 U-3	VANGUARD	UPPER MID LOWER	REDWATER	SWIFT
	Sandstone, calcareous grading into sandy limestone. Some partings of Shale Shale calcareous variegated splintery Limestone yellowish grey, finely crystalline in places oolitic	J-2	A B	LOWER SUNDANCE	L-1 L-2	SHAUNAVON	UPPER LOWER	HULETT STOCKADE-BEAVER CANYON SPRINGS	RIERDON
	Sandstone limestone and shale interbedded	J-3			L-3	GRAVELBOURG	UPPER	PIPER – SAWTOOTH	PIPER
	Dolomite yellowish grey locally cherty. Limestone shale and dolomite interbedded Anhydrite white crystalline interbedded red and green shales and red dolomitic siltstone	J-4	A B	GYPSUM SPRING	G-1 G-2	WATROUS	LOWER	GYPSUM SPRING	GYPSUM SPRING
MISSISSIPPIAN or DEVONIAN	Underlying Mississippian or Devonian								

···· D.R FRANCIS ····
AUG 1953

PLATE "I"

~ LEGEND ~

Sandstone
Siltstone
Limestone
Dolomite

Shale
Calcareous Section
Anhydrite or Gypsum
Chert

Bentonitic Shale
Sandy Shale
G Glauconite

* Productive zone at Fosterton, Lantzer Success, Gull Lake
** Productive zone at Eastend, Rapdan, Frontier, Midway, Dollard

GREY
RED
PINK
AMBER, TAN BUFF
INTERBEDDED GREEN (RED)

VARIEGATED, INCLUDING RED WHITE
DARK GREEN
LIGHT GREEN, GREENISH GREY
SHALE VARIEGATED WITHOUT RED

STRATIGRAPHY

General Statement Regarding Terminology

The terminology and formation boundaries used in this report were originally proposed by a committee on Jurassic nomenclature appointed by the Saskatchewan Geological Society in 1952. This committee suggested, as a temporary measure, the numbering system to designate the various Jurassic formations and members.

Milner and Thomas (1953) of the Tide Water Associated Oil Company have prepared a paper entitled "The Jurassic System in Saskatchewan." They found correlations with type sections in the United States doubtful, and therefore proposed new formation names for subdivisions of the Jurassic in Saskatchewan. This paper is not yet available.

The Table of Formations (Figure 1) indicates the relationship of the terminology used in this report to the nomenclature proposed by Vigrass (1952) and Milner and Thomas (1953). Formation names commonly used by oil companies, in well completion reports filed with the Department of Mineral Resources, are also indicated.

J-4 Formation

Formation Boundaries—The J-4 is the oldest formation of the Jurassic and it is divided into a lower member, J-4-B, consisting of anhydrite, red shale, and red dolomitic siltsone; and an upper member, J-4-A, consisting of interbedded dolomite, limestone and minor amounts of sandstone.

The J-4 formation rests unconformably on Paleozoic rocks over the entire area. Figure 1 indicates that the underlying Paleozoic surface is Mississippian in age, except in the northern-most part of the area, where it is Devonian.

In south central Saskatchewan, the base of the J-4 formation is placed at the top of the Charles evaporites (Mississippian). By using this marker to determine the lower boundary, it is realized that some sediments of Triassic or Mississippian age may be included in the J-4. The Spearfish formation of Triassic age and the Big Snowy Group of Mississippian age are well developed in North Dakota, and consist in part of red beds, similar in lithologic characteristics to basal J-4-B sediments. The Spearfish formation and some units of the Big Snowy Group may extend northward into Saskatchewan and would be included in the J-4 formation.

The upper boundary of the J-4 formation is placed at the first occurrence of dolomite below the J-2-B limestone. This dolomite is generally yellowish gray, finely crystalline and porous. Locally it contains thin bands of bluish chert.

Lithologic Features of the J-4-B Member—The J-4-B is an evaporitic series of sediments consisting of anhydrite, red shale, red dolomitic siltstone and minor amounts of greenish gray, calcareous shales.

The upper boundary of this member is placed at the top of the lowest occurrence of anhydrite beds in the Jurassic. The J-4-B is disconformably overlain by the J-4-A member, which relationship is exhibited by the Pre-Cretaceous paleogeologic map (Fig. 3). The lower boundary of the J-4-B is the unconformable Jurassic-Paleozoic contact.

The J-4-B member can conveniently be divided into two units. The lower unit consists predominantly of interbedded red and green shales and red dolomitic siltstone; the upper unit consists principally of anhydrite or gypsum. Thin stringers of anhydrite may occur in the lower unit. The upper unit is frequently interbedded with minor amounts of limestone, dolomite or shale.

The lower unit has been diamond-cored in the Sohio Standard Viceroy No. 1 (Lsd. 16-11-6-25w2) well. The description of these cores is as follows:

K.B.-2394. Depth 4640.

	Feet
1. Shale, light olive gray (5Y6/1) to brownish gray (5YR6/1) with pockets of white crystalline anhydrite.	1
2. Shale, brownish gray (5YR6/1) to grayish red (10R4/2) with pockets and bands of white crystalline anhydrite up to 1″ in thickness. Scattered irregularly throughout are pale green (5G7/2) shaly partings, giving the core a mottled appearance.	25
3. Shale, silty, in places dolomitic, moderate reddish brown (10YR4/4) to grayish red (10R6/1) to pale green (5G7/2), grading in places into argillaceous siltstone. Throughout the core, numerous, well-rounded, frosted, coarse grains of floating quartz sand occur. A few pockets of white crystalline anhydrite are noticeable.	95
4. Shale, very silty, grading in places into argillaceous siltstone, dolomitic, light brown (5YR5/6) to moderate brown (10YR4/4) with a few pockets of white crystalline anhydrite.	8
5. Shale, slightly silty, in places dolomitic, interbedded with calcareous, argillaceous, light brown (5YR5/6) siltstone.	42
	171

The contact of the Mississippian and the J-4-B was cored in the Viceroy No. 1 well. The contact zone consists of a very fine breccia containing small angular fragments of Mississippian dolomite in a matrix of reddish argillaceous J-4-B siltstone. Coarse, frosted, well-rounded, floating quartz sand grains also occur in the matrix.

The upper unit of the J-4-B member consists principally of anhydrite, with minor amounts of dolomite, limestone and shale occurring as thin beds. In the northern part of the area some thin stringers of gypsum occur with the anhydrite.

The anhydrite, generally medium to coarsely crystalline, has a distinct snow white color; however, in a few wells confined to the southeastern part of the area, light gray, pink, and orange colors may also occur.

The limestone or dolomite beds of this unit are yellowish gray, coarsely crystalline or saccharoidal and frequently chalky. Shale beds which occur in the upper unit of the J-4-B are commonly variegated

and splintery. The calcareous nature of these shales is variable; brown and red colored shales are generally non-calcareous, and yellow and green shales calcareous.

This unit is well represented in the Tide Water Forget Crown No. 1 (Lsd. 2-11-9-7-w2) well. The section (from cuttings) is as follows:

K.B.-2001. Depth 3675.

	Feet
1. Anhydrite, snow white, coarsely crystalline.	10
2. Limestone, dolomitic, yellowish gray (5Y8/1), finely crystalline with inclusions of white crystalline anhydrite.	10
3. Anhydrite, snow white to light gray and buff, medium crystalline.	25
4. Shale, variegated, light olive gray (5Y6/1), greenish gray (5GY6/1), moderate reddish brown (10R4/6), calcareous to dolomitic, in places splintery.	8
5. Anhydrite, similar to unit 3.	5
6. Shale, greenish gray (5GY6/1), highly calcareous, in places silty.	5
7. Anhydrite, soft, chalky white, occurring together with dolomite, which is yellowish gray (5Y9/1) and contains anhydrite filled vugs.	7
8. Anhydrite, shale and dolomite finely interbedded. Anhydrite is snow white, crystalline. Shale, calcareous, light gray (N7) to greenish gray (5GY6/1). Dolomite, yellowish gray (5Y8/1), finely crystalline.	15
9. Anhydrite, snow white to light gray (N7), fine to medium crystalline.	8
10. Shale, highly calcareous, greenish gray (5GY6/1).	5
11. Dolomite, argillaceous, very pale orange (10YR8/2), finely crystalline.	8
	106

Lithologic Features of the J-4-A Member—The J-4-A is a marine member consisting of interbedded dolomite, limestone, shale and in places some calcareous sandstone.

The upper boundary of this member is marked by yellowish gray, medium crystalline, in places porous dolomite. In the western and west-central part of the province, a consistent zone of bluish chert occurs with the dolomite. In the east and east-central part of the area, the development of this chert zone is erratic and does not occur in many wells.

Near the western and eastern boundaries of the province, where the member is comparatively thin, dolomite and limestone are the dominant rock types of the J-4-A. In the central part of the area, however, the J-4-A thickens considerably and a basal unit of variegated green, red and yellow shale develops, the thickness of which sometimes exceeds 50 feet.

Minor amounts of anhydrite occur in the J-4-A member, particularly in wells located in the central and eastern part of Saskatchewan. This anhydrite commonly occurs as filling of vugs in the limestone and dolomite beds of the J-4-A.

This member is well developed in the Sohio Bailey Selburn Montague Lake No. 1 (Lsd 11-19-5-28w2) well. The section (from cores and cuttings) is as follows:

K.B.-2930. Depth 5240.

1. Dolomite, yellowish gray (5Y8/1), finely crystalline to medium crystalline, some fragments sandy. A few fragments of bluish translucent chalcedony occur. (cuttings)	30
2. Siltstone, argillaceous, calcareous, glauconitic, moderate yellow green (5GY7/4), well-indurated; composed of clear angular quartz grains. (core)	3
3. Limestone, light olive gray (5Y5/2), dense to lithographic, with small veins of calcite scattered throughout. (core)	2
4. Siltstone, argillaceous, calcareous, variegated light gray (N7), greenish gray (5GY6/1) and moderate yellow (5Y7/6); highly micaceous. (core)	2
5. Shale, calcareous to dolomitic, silty, mottled greenish gray (5GY6/1), yellowish brown (10YR5/4) and brick red. (core)	2
6. Limestone, argillaceous, dense to lithographic, pale yellowish brown (10YR6/2), contains small inclusions of white calcite. (core)	2
7. Shale, grayish red (10R4/2), in places mottled greenish gray (5GY6/1), slightly calcareous. (core)	3
8. Limestone, argillaceous, light olive gray (5Y7/2), dense to lithographic. (core)	4
9. Shale, highly calcareous, grading into argillaceous limestone, light greenish gray (5G8/1), slightly micaceous. (core)	1
10. Limestone, dolomitic, chalky, very pale orange (10YR8/2), medium crystalline. (core)	1
11. Limestone, yellowish gray (5Y7/2), lithographic. (core)	1
12. Dolomite, calcareous, medium crystalline, chalky, very pale orange (10YR8/2). (core)	3
13. Shale, highly calcareous, greenish gray (5GY6/1). (core)	1
14. Limestone, dolomitic, chalky, medium crystalline, very pale orange (10YR8/2). (core)	2
15. Shale, calcareous, light greenish gray (5GY8/1). (core)	1
16. Shale, variegated, pale reddish brown (10R5/4), greenish gray (5GY6/1) and grayish black (N2); brown and green shales, calcareous; grayish black shales, non-calcareous. Some fragments bentonitic. (cuttings)	40
17. Shale, silty, in places grading into argillaceous siltstone and shales, some dark bituminous staining. (cuttings)	20
	118

Thickness and Distribution—The J-4 is the most widespread Jurassic formation in Saskatchewan. Figure 3 indicates the northern limits of the J-4-A and J-4-B members. The J-4-B member does not extend as far west as the Alberta-Saskatchewan border. Its absence in this part of the area is probably due to non-deposition rather than to removal by erosion after deposition.

The J-4 formation varies greatly in thickness over the area, being best developed in central Saskatchewan and thinning to the west and east. In addition, local variations in thickness occur due to the J-4 sediments filling irregularities in the Mississippian erosion surface.

The J-4 attains a maximum thickness of about 493 feet in the Shell Oungre No. 1 (Lsd. 7-1-2-14-w2) well, the J-4-B member being 425 feet and the J-4-A member 68 feet thick.

J-3 Formation

Formation Boundaries—The J-3 formation is a heterogeneous unit of marine shales, limestones and sandstones, which overlies the J-4 formation and underlies the J-2-B limestone member. Both the upper and lower boundaries of the J-3 are conformable.

Due to the absence of consistent lithologic characters within the formation, it is delimited by the base of the J-2-B and by the dolomite at the top of the J-4-B.

Lithologic Features—The J-3 formation consists of interbedded, calcareous sandstone, calcareous, greenish gray shale, and abundant limestone. Facies changes within the formation are very pronounced and individual beds can rarely be traced for any great distance.

While it is difficult to correlate units of this formation between wells, some regional variations are apparent. In the southwest, the J-3 formation is quite thin and is composed almost entirely of greenish gray calcareous shale. Some thin beds of calcareous, pyritic, quartzose sandstone occur near the base. In the central and south-central part of Saskatchewan, the member is thicker and contains beds of limestone up to 50 feet in thickness. In the eastern part of the area, the formation becomes sandy and consists primarily of interbedded sandstone and shale.

The Imperial Senate No. 14-7 (Lsd 14-7-5-27-w3) well has a J-3 section which is typical for south-western Saskatchewan. The section (from cuttings) is as follows:

K.B.-3194. Depth 4400.

	Feet
1. Shale, greenish gray (5GY6/1) to dark greenish gray (5GY4/1), calcareous, laminated, splintery.	40
2. Sandstone, quartzose, slightly calcareous, well-indurated, light gray (N7) to yellowish gray (5Y8/1), some partings of black carbonaceous material; sandstone composed of fine, clear, angular, well-sorted, quartz grains.	5
	45

The Shell Wood Mountain No. 5 (Lsd 10-11-3-9-w3) well illustrates the lithologic features of the J-3 formation in west-central Saskatchewan. The section (from cuttings) in that well is as follows:

K.B.-3098. Depth 4793.

	Feet
1. Sandstone, quartzose, light gray (N7), calcareous, pyritic; composed of fine, well sorted, angular, clear, quartz grains.	18
2. Shale, greenish gray (5GY6/1), calcareous, some fragments bentonitic.	10
3. Shale, yellowish gray (5GY8/1) to greenish gray (5GY6/1), highly calcareous, grading into argillaceous limestone.	10
4. Sandstone, quartzose, highly calcareous, grading into sandy limestone, very light gray (N8); composed of fine to medium, poorly-sorted, angular, clear, quartz grains.	9
5. Shale, greenish gray (5GY6/1), calcareous, laminated, splintery.	4
6. Sandstone as unit 4.	6
7. Sandstone, quartzose, light gray (N7), slightly calcareous, some carbonaceous partings; composed of fine, well-sorted, angular, clear, quartz grains.	7
8. Shale, greenish gray (5GY6/1), calcareous, in places laminated.	10
9. Limestone, highly argillaceous grading into calcareous shale, medium gray (N5) to yellowish gray (5Y8/1).	10
10. Shale, greenish gray (5GY6/1), calcareous, laminated.	10
11. Limestone, finely crystalline, yellowish gray (5Y8/1).	8
12. Limestone, sandy to silty, yellowish gray (5Y8/1), finely crystalline, having thin beds of greenish gray (5GY6/1), calcareous shale.	10
13. Shale, greenish gray (5GY6/1), calcareous.	20
14. Limestone, argillaceous, light gray (N7) to yellowish gray (5Y8/1), very finely crystalline.	30
	162

The Sohio Standard Horizon No. 1 (Lsd 16-5-7-24-w2) well, located in south-central Saskatchewan, illustrates the sandy developments which sometimes occur in the J-3 formation. The section (from cuttings) is as follows:

K.B.-2332. Depth 4420.

1. Shale, greenish gray (5GY6/1), calcareous; with thin interbeds of slightly calcareous, yellowish gray (5Y8/1), well-indurated, quartzose sandstone, in places pyritic. Sandstone consists of fine, fairly well-sorted, angular, clear, quartz grains.	45
2. Sandstone, quartzose, brownish gray (5YR6/1), well-indurated; consists of coarse to medium, poorly-sorted, fairly well-rounded, clear to frosted, quartz grains.	70
3. Shale, greenish gray (5GY6/1), calcareous, laminated; interbedded with thin bands of yellowish gray (5Y8/1), finely crystalline, in places sandy, limestone, some fragments of which are oolitic.	40
4. Shale, greenish gray (5GY6/1), calcareous, laminated, in places silty.	20
5. Limestone, yellowish gray (5Y8/1), finely crystalline.	5
6. Shale, greenish gray (5GY6/1), calcareous.	15
	195

Thickness and Distribution—The northern limits of the J-3 formation are indicated in figure 3.

The J-3 attains a maximum thickness of 195 feet in the Sohio Standard Horizon No. 1 (Lsd 16-5-7-24-w2) well. In south-central Saskatchewan, thicknesses range from 150 feet to 195 feet. Westward, the formation thins gradually to a minimum thickness of 30 feet. Eastward, the formation also thins, but to a lesser degree, and thicknesses in the order of 90 feet are common in eastern Saskatchewan.

J-2 Formation

Formation Boundaries—The J-2 is a marine, fossiliferous formation, consisting of limestone, sandy limestone and shale. It is divided into two members. The lower, J-2-B, consists of limestone, and the upper, J-2-A, consists of interbedded limestone, sandy limestone and shale. In the eastern part of the area both members of this formation undergo rapid facies changes, and sandstone and shale become the dominant rock types.

The contacts of the J-2 formation with the underlying J-3 and the overlying J-1 are conformable. In western and central Saskatchewan, the lower boundary is placed at the base of the first massive limestone beds which form the J-2-B member. In eastern Saskatchewan, however, where the J-2-B undergoes a facies change, the contact of the J-3 and J-2 formations is not well defined.

The upper boundary of the J-2 formation in western and central Saskatchewan is placed at the top of the first well-developed limestone or sandy limestone zone in the Jurassic. To the east, where the overlying member becomes sandy, distinction between the J-2-A and J-1-C members is difficult.

Lithologic Features of the J-2-B Member—In the western and central part of Saskatchewan the lithology of the J-2-B member is remarkably constant. Here the member consists of yellowish gray to very pale orange, dense to finely crystalline limestone, in places oolitic. Oolites are common

throughout the member but do not everywhere occur at the same stratigraphic position. In the western part of the Province, the member is oolitic near the top and dense and chalky toward the base. Eastward, oolites are more common, but generally occur in the basal part of the member. These oolites are generally coarse and are composed of calcite. Commonly they are gray and coated with argillaceous material.

Eastward from central Saskatchewan, the member undergoes rapid facies changes and in the extreme eastern part of the area the J-2-B loses its identity. These facies changes first appear in east-central Saskatchewan, where minor shale beds appear in the J-2-B limestone. In eastern Saskatchewan, however, the member becomes sandy and consists almost entirely of interbedded sandstone and shale with minor amounts of limestone. In this area the J-2-B is difficult to distinguish from the underlying J-3 formation or the overlying J-2-A member.

In the Imperial Tide Water Climax No. 6-10 (Lsd. 6-10-3-18-w3) well, all but the basal 26 feet of J-2-B member was cored. The section is as follows:

K.B.-3076. Depth 4550.

	Feet
1. Limestone, very fossiliferous, very pale orange (10YR8/2), medium crystalline, containing some pockets of pyrite.	2
2. Limestone, yellowish gray (5Y8/1), with abundant medium light gray (N7) oolites, medium crystalline to coarsely crystalline.	2
3. Limestone, very pale orange (10YR8/2), finely crystalline to medium crystalline, contains widely scattered pockets of pyrite; in places micaceous; contains some well-preserved fossil fragments; a few veins of coarsely crystalline calcite are shown in the core.	38
4. Limestone, very pale orange (10YR8/2), very finely crystalline to lithographic.	2
5. Limestone, pale yellowish brown (10YR6/2), very finely crystalline to lithographic.	2
6. Limestone, as unit 4.	4
7. Limestone, very pale orange (10YR8/2), very finely crystalline to lithographic.	26
	76

The Bennett and Burns Bell No. 1 (Lsd. 11-19-5-14-w2) well illustrates the facies changes that occur in this member in eastern Saskatchewan. The section (from cuttings) is as follows:

K.B.-2003. Depth 4118.

	Feet
1. Limestone, very pale orange (10YR8/2), with medium light gray (N6) argillaceous oolites; finely crystalline.	5
2. Shale, variegated, greenish gray (5GY6/1), grayish red (10R4/2), dark yellowish orange (10YR6), calcareous, laminated and somewhat splintery.	5
3. Limestone, yellowish gray (5Y8/1), medium crystalline, some fragments sandy, in places oolitic.	11
4. Sandstone, quartzose, calcareous, well-indurated, in places pyritic; composed of fine, well-sorted, clear, quartz grains.	5
5. Shale, greenish gray (5GY6/1), calcareous, laminated, in places splintery.	11
6. Sandstone, as unit 4.	5
7. Limestone, in places oolitic, yellowish gray (5Y8/1), finely crystalline, some fragments sandy.	10
8. Shale, greenish gray (5GY6/1), calcareous, laminated, in places splintery.	8
9. Limestone, very pale orange (10YR8/2) to yellowish gray (5Y8/1), finely crystalline, in places oolitic, some fragments sandy.	12
	72

Lithologic Features of the J-2-A Member—The J-2-A is a heterogeneous member consisting of interbedded sandstone, sandy limestone and shale. A consistent bed of shale occurs at the base of the member and separates the J-2-A from the J-2-B.

In the west, the J-2-A consists of yellowish gray calcareous sandstone interbedded with greenish gray calcareous shales. In many places the shale is fossiliferous. Locally, the sandstone grades into sandy limestone, and thin beds of dense yellowish gray dolomite are common. In western Saskatchewan, the shale bed which occurs at the base of the J-2-A member is very thin. To the south, this shale bed is greenish gray, while to the north, gray colours predominate. In an easterly direction, the shale bed gradually thickens to 50 feet or more and becomes variegated; red, brown, yellow and greenish gray calcareous shales are very common.

The J-2-A member, in southwestern Saskatchewan, is well developed in the Imperial Tide Water Climax No. 6-10 (Lsd. 6-10-3-18-w3) well. The section (from cores) is as follows:

K.B.-3076. Depth 4500.

1. Dolomite, sandy, yellowish gray (5Y8/1), very finely crystalline, argillaceous, grading in places into dolomitic shale.	2
2. Shale, greenish gray (5G6/1), dolomite, with scattered pockets of pyrite.	1
3. Sandstone, quartzose, yellowish gray (5Y8/1), pyritic, slightly glauconitic, contains scattered mica flakes, highly calcareous, grading in places into a sandy limestone; sandstone consists of fine, angular, fairly well-sorted, clear quartz grains.	18
4. Shale, dark greenish gray (5GY4/1), calcareous, with scattered flakes of mica, slightly pyritic; contains some pockets of calcareous sandstone.	15
5. Shale, greenish gray (5GY4/1), calcareous, pyritic, locally sandy, very fossiliferous.	9
6. Shale, dark greenish gray (5GY4/1), calcareous, fissile.	5
	50

The J-2-A member is 75 feet thick in the Imperial Tide Water Driscoll Lake No. 6-34 (Lsd. 6-34-7-13-w3) well. The section there is representative of the J-2-A member occurring in west-central Saskatchewan. The upper 50 feet is represented by core and the lower 25 feet by cuttings. The member has the following lithologic features:

K.B.-3048. Depth 4530.

	Feet
1. Sandstone, quartzose, calcareous, slightly glauconitic, well-indurated; composed of fine, well-sorted, angular, clear quartz grains.	5
2. Shale, dark greenish gray (5GY4/1), calcareous in places, silty and sandy, contains abundant fossil fragments.	5
3. Limestone, yellowish gray (5Y4/1), coarsely crystalline, in places lithographic and somewhat pyritic; contains some floating sand grains and minor partings of dark greenish gray (5GY4/1) calcareous shale.	8
4. Shale, silty, dark greenish gray (5GY4/1), in places dusky yellow (5Y6/4), calcareous, fossiliferous, with pockets of argillaceous siltstone.	8
5. Shale, variegated, light greenish gray (5G8/1) to dark greenish gray (5GY4/1) and pale reddish brown (10R5/4), calcareous, in places highly fossiliferous.	8

6. Shale, lark greenish gray (5GY4/1), calcareous, with pockets of quartzose, argillaceous sandstone.	14
7. Limestone, very pale orange (10YR8/2) to pale yellowish brown (10YR6/2), argillaceous, silty, contains minor partings of dark greenish gray (5GY4/1) to dark gray (N6) shale.	2
8. Shale, variegated, greenish gray (5GY6/1), dusky yellow (5Y6/4), grayish red (10R4/2), calcareous, laminated, splintery, interbedded with sandstone; the quartzose part yellowish gray (5Y8/1), calcareous, composed of fine, well-sorted, angular, clear quartz grains.	25
	75

In eastern Saskatchewan the J-2-A member thickens considerably and consists of sandstone, sandy limestone and variegated shale. In the Shell Estevan No. 1 (Lsd. 6-24-8-9-w2) well this member attains a thickness of 106 feet. The section (from cuttings) is as follows:

K.B.-2023. Depth 3555.

	Feet
1. Sandstone, quartzose, calcareous, yellowish gray (5Y8/1), pyritic; composed of fine, fairly well-sorted, subangular, clear quartz grains.	8
2. Shale, greenish gray (5GY6/1), calcareous.	7
3. Sandstone, as unit 1.	5
4. Sandstone, as unit 1, but highly micaceous in places; interbedded with laminated, calcareous, variegated shales of greenish gray (5GY6/1), dusky yellow (5Y6/1) and moderate reddish brown (10R4/6) colors.	46
5. Limestone, sandy, yellowish gray (5Y8/1), medium crystalline, slightly micaceous.	8
6. Shale, greenish gray, (5GY6/1) calcareous; some fragments silty.	8
7. Limestone as unit 5.	3
8. Shale, as unit 6.	5
9. Limestone, as unit 5.	5
10. Shale, variegated, calcareous, greenish gray (5GY6/1), grayish red (10R4/2), generally laminated and splintery; some greenish gray fragments are silty.	11
	106

Thickness and Distribution

Figure 3 indicates the northern extent of the J-2-A and J-2-B members.

The J-2-B member is best developed in western and central Saskatchewan where thicknesses up to 100 feet are common. Eastward the member thins, with thicknesses ranging from 40 feet to 60 feet. The member thins only slightly in a northerly direction.

The J-2-A member attains maximum development in eastern Saskatchewan where sections of as much as 120 feet have been observed. Westward, the member thins and in central Saskatchewan thicknesses of 65 or 70 feet are quite common. In the extreme western part of the area the member is very poorly-developed and thicknesses range from 20 to 30 feet.

J-1 Formation

Formation Boundaries—The J-1 formation consists of shales and sandstones. It is divided into three members. The lower, J-1-C, consists of greenish gray calcareous shale; the middle, J-1-B, consists of calcareous and non-calcareous sandstone; and the upper, J-1-A, contains mostly greenish gray, calcareous and non-calcareous shale.

The J-1 formation lies conformably on the J-2-A member, and is unconformably overlain by deposits of Lower Cretaceous age.

Lithologic Features of the J-1-C Member—This member consists of marine, calcareous, greenish gray shales, in places interbedded with minor amounts of calcareous sandstone or siltstone. Locally the shales are variegated near the base of the member.

Shales of the J-1-C member are generally calcareous, greenish gray to dark greenish gray, splintery and laminated. They are commonly silty, particularly in the basal part of the member. In south-central Saskatchewan, bentonitic shales occur in the upper part of the J-1-C. In the central and east-central part of the area, some light olive gray, brownish gray and dusky yellow shales occur, together with greenish gray shale near the base of the member.

Limestone, sandstone and siltstone are minor constituents of the J-1-C in the western part of the area and occur as thin beds within the shale. Eastward, however, the J-1-C member becomes sandy and silty. In the extreme eastern part of Saskatchewan the member consists of interbedded sandstone and shale and commonly resembles the underlying J-2-A in lithology.

The J-1-C member, in western Saskatchewan, is well represented in the Co-op Cypress Hills No. 1 (Lsd. 14-2-5-25-w3) well. The member attains the thickness of 150 feet, of which the lower 30 feet is represented by core. The section is as follows:

K.B.-3670. Depth 4706.

	Feet
1. Shale, calcareous, greenish gray (5GY6/1); finely laminated, with a few thin beds of argillaceous, yellowish gray (5Y8/1) and light gray (N7) dense limestone.	70
2. Shale, calcareous, greenish gray (5GY6/1) finely laminated; interbedded with thin bands of light olive gray (5Y6/1) to yellowish gray (5Y8/1) dense to very finely crystalline, argillaceous limestone.	20
3. Shale, highly calcareous, greenish gray (5GY6/1), fissile.	30
4. Shale, highly calcareous, greenish gray, (5GY6/1) grading in places into yellowish gray (5Y8/1), argillaceous limestone; glauconitic, contains some poorly-preserved fossil fragments.	25
5. Shale, light olive gray (5Y6/1), calcareous, pyritic.	5
	150

In central Saskatchewan variegated shales occur in the basal part of the J-1-C member. In the Sohio Bailey Selburn Montague Lake No. 1 (Lsd. 11-19-5-28-w2) well the J-1-C section (from cuttings) is described as follows:

K.B.-2930. Depth 4620.

	Feet
1. Shale, greenish gray (5GY6/1), calcareous, in places laminated and splintery, some fragments highly bentonitic; interbedded with minor amounts of light gray, well-indurated, calcareous, argillaceous, quartzose siltstone.	115

2. Siltstone, highly calcareous, argillaceous in places, yellowish gray (5Y8/1), well-indurated, with scattered pellets of glauconite. 15

3. Shale, greenish gray (5GY6/1), in places laminated and splintery, some fragments silty; contains thin beds of yellowish gray (5Y8/1) to light greenish gray (5GY8/1), calcareous, argillaceous siltstone. 120

4. Shale, calcareous, variegated, greenish gray (5GY6/1), dark greenish gray (5GY4/1), light olive gray (5Y6/1); many fragments silty, in places grading into argillaceous siltstone. 60

310

Lithologic Features of the J-1-B Member—The J-1-B member consists of calcareous and non-calcareous quartzose sandstone, in places interbedded with greenish gray shale.

In the extreme southwest part of the province the J-1-B member undergoes a facies change and grades into light gray, finely crystalline, argillaceous limestone. This limestone is generally interbedded with greenish gray laminated shales.

The J-1-B member is best developed in the west-central part of the province, where two distinct sandstone units occur separated by a bed of shale. Westward, only one sandstone unit occurs, and the member in general becomes silty and shaly.

The sandstone of this member is not consistent in lithologic character and varies locally to a considerable extent. It is generally calcareous and composed of fine, fairly well-sorted, angular to sub-rounded, clear quartz grains. Glauconite is common but not always present. The sandstone is, in most places, well-indurated, but locally unconsolidated. It is slightly calcareous, but in places becomes very calcareous and grades into sandy limestone. Kaolinite is fairly common in the J-1-B member.

The Tide Water Johnston Lake No. 1 (Lsd. 9-20-12-3-w3) well, illustrates the lithology of the J-1-B member in the west-central part of the province. The section consists of two sandstone units. The member is 110 feet thick, of which the upper 45 feet are represented by cores and the lower 65 feet by cuttings. The section is as follows:

K.B.-2421. Depth 3605.

Feet

1. Sandstone, quartzose, very light gray (N8), slightly calcareous, poorly-indurated, and slightly kaolinitic; composed of fine to medium, fairly well-sorted, angular to sub-rounded, clear quartz grains. 5

2. Sandstone, quartzose, very light gray (N8), highly calcareous, grading into sandy limestone, well-indurated, contains a few pockets of pyrite; composed of fine to medium, fairly well-sorted, angular to sub-rounded, clear quartz grains. 10

3. Sandstone, quartzose, very light gray (N8), slightly calcareous, poorly-indurated, in places becoming loose and unconsolidated; composed of fine, angular to sub-rounded, clear quartz grains. 33

4. Shale, dark greenish gray (5G6/1), slightly calcareous, with platy fractures. 2

5. Shale, as unit 4, interbedded with minor amounts of sandstone as unit 3. 15

6. Sandstone, quartzose, very light gray (N8), highly calcareous, grading in places into sandy limestone, well-indurated; composed of fine, fairly well-sorted, rounded to sub-angular, clear quartz grains. 10

7. Sandstone, as unit 3. 15

8. Sandstone, quartzose, very light gray (N8), calcareous, well-indurated; composed of fine, well-sorted, angular, clear quartz grains. 20

110

In the westernmost part of the area the J-1-B member becomes shaly and silty and generally consists of only one unit. The member is 88 feet thick in the Imperial Driscoll Lake No. 6-34 (Lsd. 6-34-7-13-w3) well. The section (from cores) is as follows:

K.B.-3048. Depth 4249.

	Feet
1. Siltstone, quartzose, argillaceous, yellowish gray (5Y8/1), calcareous, and sometimes micaceous.	3
2. Shale, fossiliferous, greenish gray (5GY6/1), calcareous.	2
3. Siltstone, quartzose, yellowish gray (5Y8/1), with light greenish gray (5G8/1) and dark greenish gray (5GY4/1) shaly partings; calcareous, slightly pyritic, with scattered flakes of mica.	5
4. Sandstone, quartzose, very light gray (N7), calcareous; composed of very fine, well-sorted, subangular, clear, quartz grains.	4
5. Shale, silty, light greenish gray (5GY8/1), calcareous, with abundant pyrite.	1
6. Shale, fossiliferous, silty, greenish gray (5GY6/1), calcareous, containing pockets of finely disseminated pyrite.	8
7. Siltstone, quartzose, argillaceous, light greenish gray (5GY6/1), calcareous, and quite fossiliferous.	2
8. Sandstone, quartzose, light greenish gray (5G8/1), with scattered pellets of glauconite; composed of fine, well-sorted, rounded, clear quartz grains.	6
9. Shale, silty, dark greenish gray (5GY4/1), calcareous, fossiliferous, in places containing pockets of siltstone.	18
10. Sandstone, quartzose, very light gray (N8), calcareous, containing scattered pellets of glauconite, somewhat pyritic, well-indurated; composed of fine, well-sorted, rounded, clear quartz grains.	3
11. Shale, greenish gray (5GY6/1) to dark greenish gray (5GY4/1), calcareous, in places silty, fossiliferous, and micaceous.	15
12. Sandstone, quartzose, light greenish gray (5GY8/1), argillaceous, calcareous, kaolinitic; composed of fine, well-sorted, subangular, clear quartz grains.	8
13. Shale, dark greenish gray (5GY4/1), aclcareous, fissile, pyritic.	3
14. Sandstone, as unit 12.	10
	88

Lithologic features of the J-1-A Member—The J-1-A member includes the youngest sediments of Jurassic age in Saskatchewan. It consists of greenish gray, bentonitic, laminated, splintery, calcareous and non-calcareous shales.

Near the base, the member consists of greenish gray, in places silty, frequently laminated, splintery and slightly calcareous shales. These shales resemble those of the J-1-C member, but differ in being very slightly calcareous and quite commonly non-calcareous.

In the upper part of the member the shales are greenish gray, non-calcareous and generally highly bentonitic. Near the Jurassic-Blairmore contact variegated red, yellow and brown shales are common.

Thickness and Distribution. Figure 3 indicates the northern extent of the J-1-C member. The J-1-C member is remarkably uniform and rapid changes in thickness do not occur except where it has been partially removed by erosion. The member gradually thickens from west to east, being about 150 feet thick in western Saskatchewan and attaining a maximum thickness of 315 feet in south-central Saskatchewan.

The northern extent of the J-1-B member is also indicated in Figure 3.

In west-central Saskatchewan, where it is best developed, the J-1-B varies from 100 to 135 feet in thickness. In southwestern and east-central Saskatchewan the thickness of J-1-B varies from 30 to 70 feet.

The J-1-A, constituting the youngest sediments of Jurassic age, was subjected to erosion at the close of Jurassic time. Consequently, many local variations in thickness are observed. The member thickens from west to east, being about 150 feet thick in western Saskatchewan and thickening to as much as 250 feet in central and eastern Saskatchewan.

Jurassic-Lower Cretaceous Contact

Lower Cretaceous sediments of the Blairmore formation unconformably overlie the Jurassic strata in Saskatchewan. The Blairmore formation consists of interbedded gray shale and sandstone.

Basal sandstone beds of the Blairmore formation commonly resemble those of the J-1-B member. In areas where the J-1-A member has been removed by erosion and basal Blairmore sands rest directly and unconformably on the J-1-B member, the Jurassic-Lower Cretaceous contact may be difficult to determine.

In some cases the problem of the Jurassic-Lower Cretaceous contact can be solved by observing the thickness of the J-1-C member. This member is of uniform thickness over wide areas. If, in places, a rapid thinning of the J-1-C member is evident, it can be assumed that erosion has removed the J-1-A, J-1-B and part of the J-1-C, and that any sandstone units overlying the J-1-C member belong to the Blairmore formation rather than the J-1-B member. This relationship is illustrated by figures 9 and 10.

ECONOMIC GEOLOGY

General Statement

Oil has been discovered in Jurassic deposits of Saskatchewan at Eastend, Frontier, Rapdan, Gull Lake, Fosterton, Cantuar, Java, Midway, Wapella and more recently at Dollard. In addition, a good oil show was encountered at Dahinda. All oil produced from the Jurassic to date has been of the medium gravity type, (20 to 25 degrees A.P.I.).

More drilling will have to be done before any one Jurassic formation or member can be ruled out as a possible petroleum producer. However, on the basis of lithology, some general conclusions can be drawn regarding the possibility of hydrocarbon accumulation in the various formations and members. These may be outlined as follows:

J-4 Formation

J-4-B Member—This member consists predominantly of the evaporitic type of sediments which are not favorable for the accumulation of petroleum. No discoveries have been reported to date in the J-4-B.

J-4-A Member—Beds of sandstone which occur in the J-4-A member at some localities could conceivably trap petroleum. The only significant oil show reported in this member to date was in the Shell Dahinda No. 1 (Lsd. 6-2-9-23-w3) well. In this well, a thin sandstone bed, 35 feet below the top of the J-4-A, yielded 36 barrels of fresh water and 6 barrels of 32 degrees A.P.I. oil upon swabbing for 10 hours.

J-3 Formation

This formation should have petroleum possibilities, particularly in Eastern Saskatchewan where several porous sandstone beds of considerable thickness occur in the J-3 formation. These beds, where encountered to date, have yielded only salt water. However, sufficient drilling has yet to be done up-dip, where these sandstone beds lens out, to determine their petroleum possibilities.

Several of the potential oil producing zones in the Wapella field are Jurassic in age. Rapid facies changes make it difficult to correlate the Jurassic section at and around Wapella with the section to the west. Preliminary study seems to indicate that some of the potential producing sands in the Wapella area belong to the J-3 formation.

J-2 Formation

This formation has proved to be one of the most productive zones in western and southwestern Saskatchewan. Oil has been discovered in the J-2 formation at Eastend, Frontier, Dollard and Midway.

Oil, when present, generally occurs in both the J-2-A and J-2-B members. Of these two members, the J-2-A has proved to be more productive than the J-2-B.

J-1-C Member—No petroleum discoveries have been reported to date in the J-1-C member. The possibilities of petroleum occurrence in this member are slight, as it consists almost entirely of shale.

J-1-B Member—This member constitutes the producing zone at Fosterton, Cantuar, Success, and Gull Lake, where it is known as the "Roseray sand." Much of the present drilling activity in the central part of Saskatchewan is directed towards finding localities where the J-1-B member lenses out up-dip.

J-1-A Member—As this member consists almost entirely of shale, the possibilities of petroleum occurrences are slight. No oil or gas has been encountered in this member to date.

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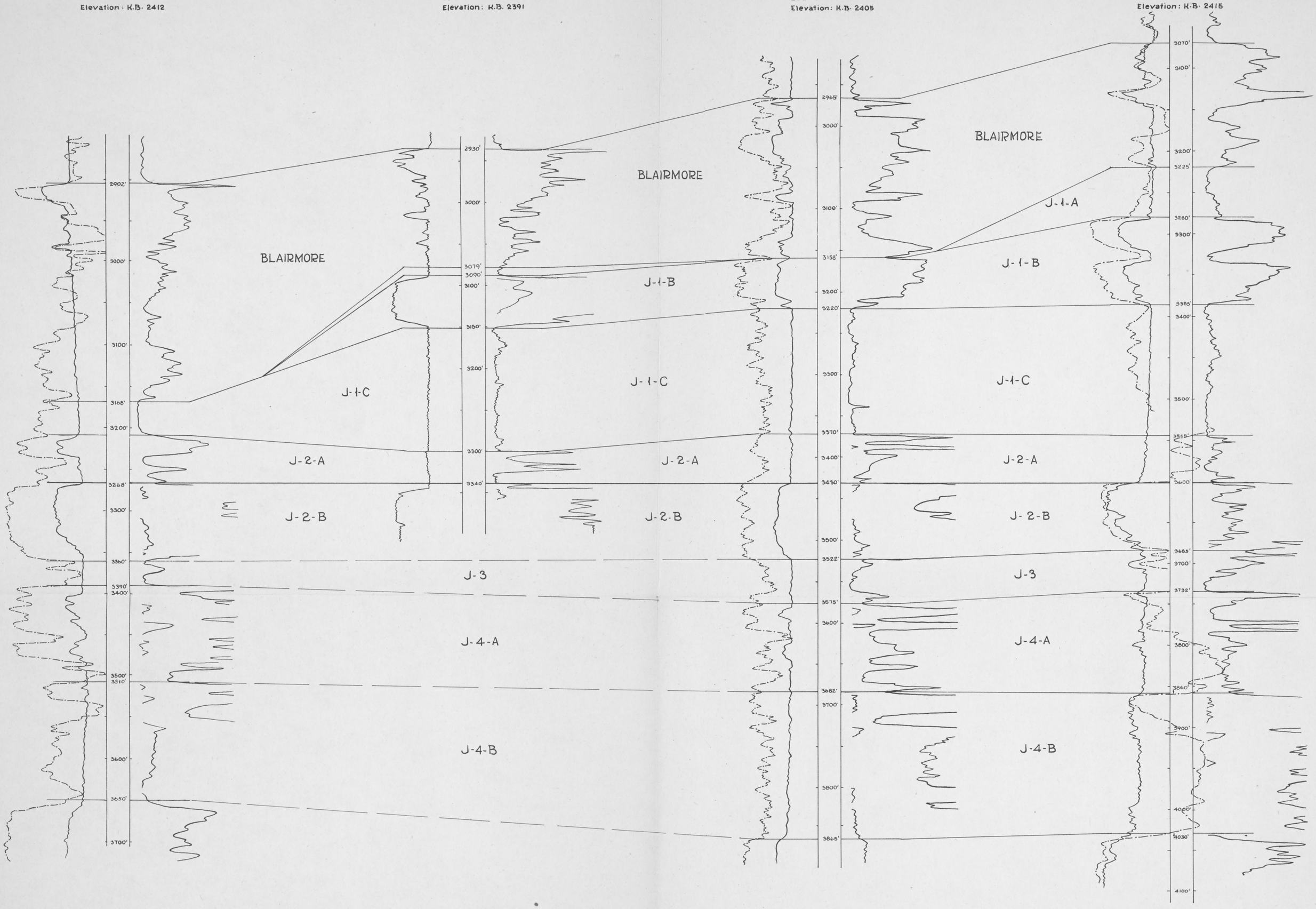
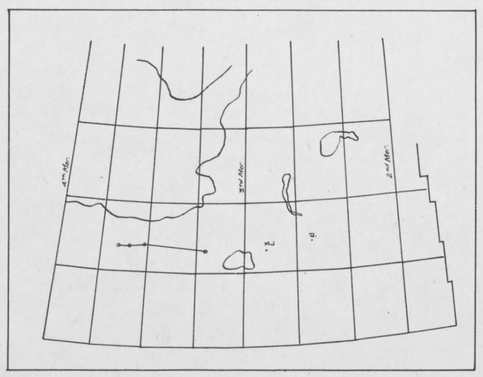
SOCONY VACUUM
ROSERAY # 10-10B
Lsd. 10-10-17-19 W.3
Elevation: K.B. 2412

SOCONY VACUUM
FOSTERTON # 14-5B
Lsd. 5-14-17-18 W.3
Elevation: K.B. 2391

TIDEWATER
ROBERTSON # 1
Lsd. 7-9-17-15 W.3
Elevation: K.B. 2405

TIDEWATER
KELSTERN CROWN # 1
Lsd. 5-28-15-6 W.3
Elevation: K.B. 2415





ELECTRIC LOG
CORRELATION PROFILE
ROSERAY 10-10B to KELSTERN CROWN 1

FIGURE X

CABRI CROWN # 2

TIDEWATER ASSOC.
L.S.D. 8 SEC. 18 TWP. 19 RGE. 17 W.3
Elevation: K.B. 2164'

S.W.P. WHEAT VALLEY # 31-6B

SOCONY VACUUM
L.S.D. 6 SEC. 31 TWP. 17 RGE. 17 W.3
Elevation: K.B. 2354

S.W.P. CANTUAR # 2-14

SOCONY VACUUM
L.S.D. 14 SEC. 2 TWP. 16 RGE. 17 W.3
Elevation: K.B. 2496'

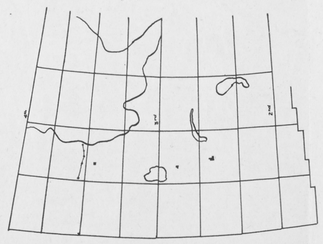
S.W.P. WEST COVINGTON # 35-16B

SOCONY VACUUM
L.S.D. 16 SEC. 35 TWP. 13 RGE. 17 W.3
Elevation: K.B. 2833'

T.W. INSTOW CROWN # 1

TIDEWATER ASSOC.
L.S.D. 15 SEC. 33 TWP. 8 RGE. 17 W.3

BLAIRMORE
J-1-A
J-1-B
J-1-C
J-2-A
J-2-B
J-3
J-4-A
J-4-B



ELECTRIC LOG
CORRELATION PROFILE
— CABRI CROWN 2 - INSTOW CROWN 1

FIGURE IX

8 | 12 | 13 | 14 | 15 | 16 | 17

SHELL OIL COMPANY
BIG MUDDY LAKE #1
Lsd. 14-12-3-21-W2
Elevation: K.B. 2548'

BENNETT AND BURNS
BELL #1
Lsd. 11-19-5-14-W2
Elevation: K.B. 2005'

SHELL OIL COMPANY
MIDALE #A-7-18
Lsd. 7-18-6-10-W2
Elevation: K.B. 2000'

SHELL OIL COMPANY
ESTEVAN #1
Lsd. 6-24-8-9-W2
Elevation: K.B. 2023'

TIDEWATER ASSOCIATED OIL COMPANY
FORGET CROWN #1
Lsd. 2-11-9-7-W2
Elevation: K.B. 2001'

TIDEWATER ASSOCIATED OIL COMPANY
BENDER CROWN #1
Lsd. 13-11-12-5-W2
Elevation: K.B. 2498'

IMPERIAL OIL COMPANY
WAPELLA #4-3
Lsd. 4-3-15-1-W2
Elevation: K.B. 1949'

J-1-A
J-1-B
J-1-C
J-2-A
J-2-B
J-3
J-4-A
J-4-B

SCALE CHANGE

FIGURE · VIII ·

LOCATION MAP

CORRELATION PROFILE OF
JURASSIC STRATA
FROM
BIG MUDDY LAKE #1 — WAPELLA #4-3

D. R. FRANCIS ····· 1953

·· LEGEND ··

- sandstone
- Siltstone
- Shale
- Calcareous Section
- Sandy Shale
- Bentonitic Shale
- Coal
- Bentonite
- Limestone
- Sandy Limestone
- Argillaceous Limestone
- Dolomitic Limestone
- Dolomite
- Cherty Limestone
- Oolitic Limestone
- Anhydrite or Gypsum
- Chert
- Glauconite

- Grey
- Red, Brownish red
- Pink
- Brown, Tan, Buff
- Variegated, including red
- Variegated, no red
- White
- Dark green, Olive green
- Light green, Green grey
- Interbedded red & green

- Cored Interval

18

TIDEWATER ASSOCIATED OIL COMPANY
JOHNSTON LAKE CROWN #1
Lsd: 9-20-12-2-W3
Elevation: K.B. 2421'

19

SOHIO PETROLEUM COMPANY
LEAKVILLE #1
Lsd: 4-11-14-26 W2
Elevation: K.B. 2055'

20

SOCONY VACUUM EXPLORATION COMPANY
ESTLIN #1
Lsd. 1-20-15-19-W2
Elevation: K.B. 1922'

21

BRITISH AMERICAN OIL COMPANY
DAVIN #1
Lsd. 12-11-16-16 W2
Elevation: K.B. 2143'

22

BRITISH AMERICAN OIL COMPANY
VIBANK #1
Lsd. 5-29-15-14-W2
Elevation: K.B. 2176'

23

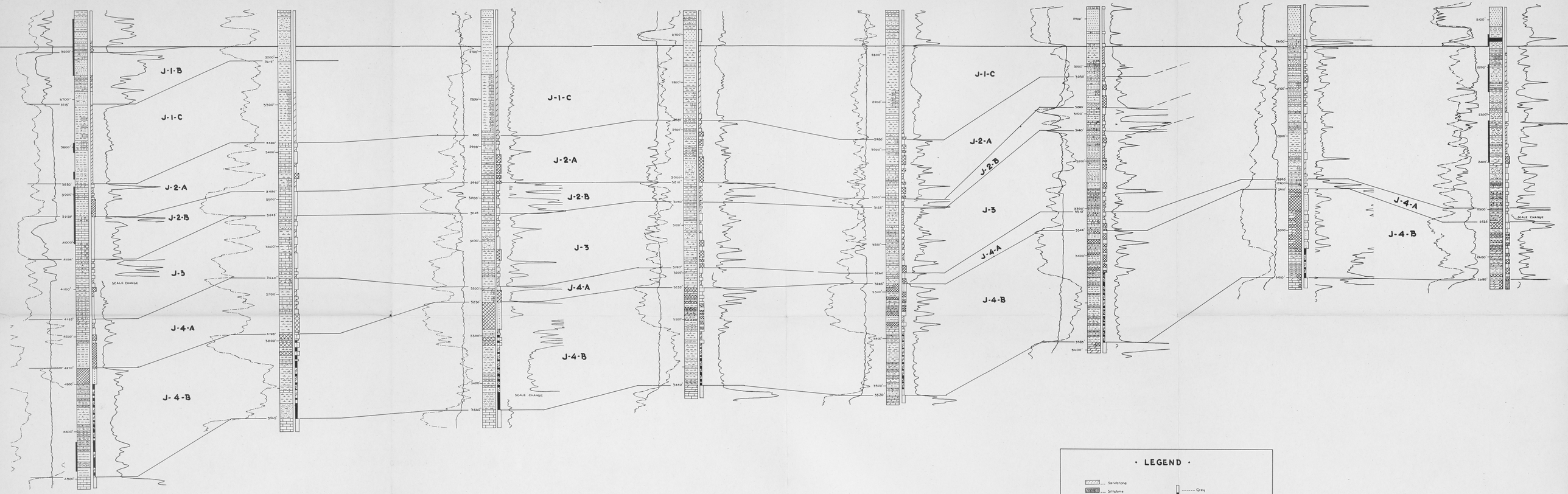
BRITISH AMERICAN OIL COMPANY
MONTMARTRE #1
Lsd. 12-11-15-11-W2
Elevation: K.B. 2275'

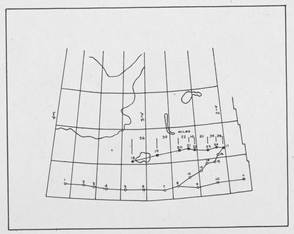
24

TIDEWATER ASSOCIATED OIL COMPANY
HILLESDEN CROWN #1
Lsd. 5-30-15-5-W2
Elevation: K.B. 2151'

17

IMPERIAL OIL COMPANY
WAPELLA #4-3
Lsd. 4-3-15-1 W2
Elevation: K.B. 1949'





LOCATION MAP

CORRELATION PROFILE OF
JURASSIC STRATA
FROM
JOHNSTON LAKE CROWN #1 — WAPELLA #4-3

· LEGEND ·

- Sandstone
- Siltstone
- Shale
- Calcareous Section
- Sandy Shale
- Bentonitic Shale
- Coal
- Bentonite
- Limestone
- Sandy Limestone
- Argillaceous Limestone
- Dolomitic Limestone
- Dolomite
- Cherty Limestone
- Oolitic Limestone
- Anhydrite or Gypsum
- Chert
- Glauconite

- Grey
- Red, Brownish red
- Pink
- Brown, Tan, Buff
- Variegated, including red
- Variegated, no red
- White
- Dark green, Olive green
- Light green, Green grey
- Interbedded, red & green

- Cored Interval

-- D.R. FRANCIS.... 1955 --

FIGURE VII

1

IMPERIAL OIL LIMITED
BATTLE CREEK #4-31
Lsd. 4-31-3-26-W.5
Elevation: K.B. 3072

2

TIDEWATER ASSOCIATED OIL COMPANY
FRONTIER CROWN #1
Lsd. 15-21-3-20-W.5
Elevation: K.B. 2965

3

IMPERIAL OIL LIMITED
CLIMAX #6-10
Lsd. 6-10-3-18-W.5
Elevation: K.B. 3078

4

IMPERIAL OIL LIMITED
MASLEFIELD #6-34
Lsd. 15-31-2-14-W.5
Elevation: K.B. 2922

5

SHELL OIL COMPANY
WOOD MOUNTAIN #5
Lsd. 10-11-3-9-W.5
Elevation: K.B. 3098

6

SOHIO STANDARD REGENT
WOOD MOUNTAIN #1
Lsd. 9-18-3-3-W.5
Elevation: K.B. 3259

7

SOHIO PETROLEUM COMPANY
GAP #1
Lsd. 16-10-3-25-W.2
Elevation: K.B. 2746

8

SHELL OIL COMPANY
BIG MUDDY LAKE #1
Lsd. 44-19-3-31-W.2
Elevation: K.B. 2548

9

SHELL OIL COMPANY
OUNGRE #1
Lsd. 7-1-2-14-W.2
Elevation: K.B. 2206

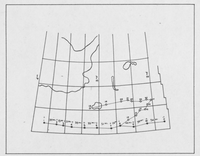
10

JAMES R. OWEN DRILLING COMPANY
JAMES R. OWEN #1
Lsd. 12-16-2-7-W.2
Elevation: K.B. 1888

11

SOCONY VACUUM EXPLORATION COMPANY
CARIEVALE #1
Lsd. 16-4-3-32-W.1
Elevation: K.B. 1647 -

J-1-A
J-1-B
J-1-C
J-2-A
J-2-B
J-3
J-4-A
J-4-B



LOCATION MAP

CORRELATION PROFILE
JURASSIC STRATA
FROM
BATTLE CREEK # 4-31 — CARIEVALE # 1

FIGURE VI

D. R. FRANCIS 1953

LEGEND

Sandstone
Siltstone
Shale
Calcareous Section
Sandy Shale
Bentonitic Shale
Coal
Bentonite
Limestone
Sandy Limestone
Argillaceous Limestone
Dolomitic Limestone
Dolomite
Cherty Limestone
Calitic Limestone
Anhydrite or Gypsum
Chert
Glauconite

Grey
Red, Brownish red
Pink
Brown, Tan, Buff
Variegated, including red
Variegated, no red
White
Dark green, Olive green
Light green, Green-grey
Interbedded, red & green

Cored Interval

ISOPACH MAP OF SASKATCHEWAN
JURASSIC

D. R. FRANCIS
AUGUST, 1953

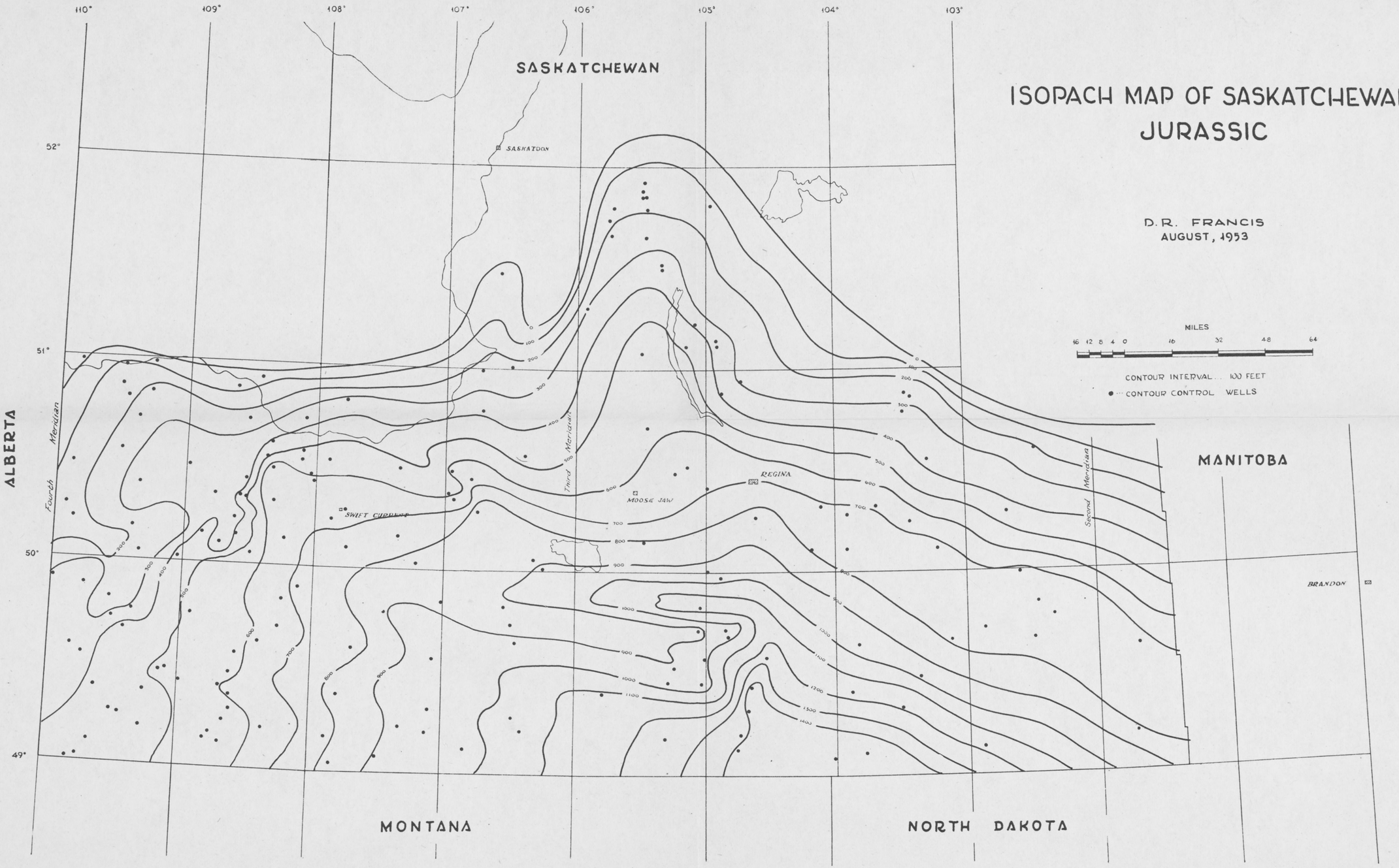


FIGURE · V ·

STRUCTURE CONTOUR MAP ON TOP OF J-2-B MEMBER

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AUGUST, 1953

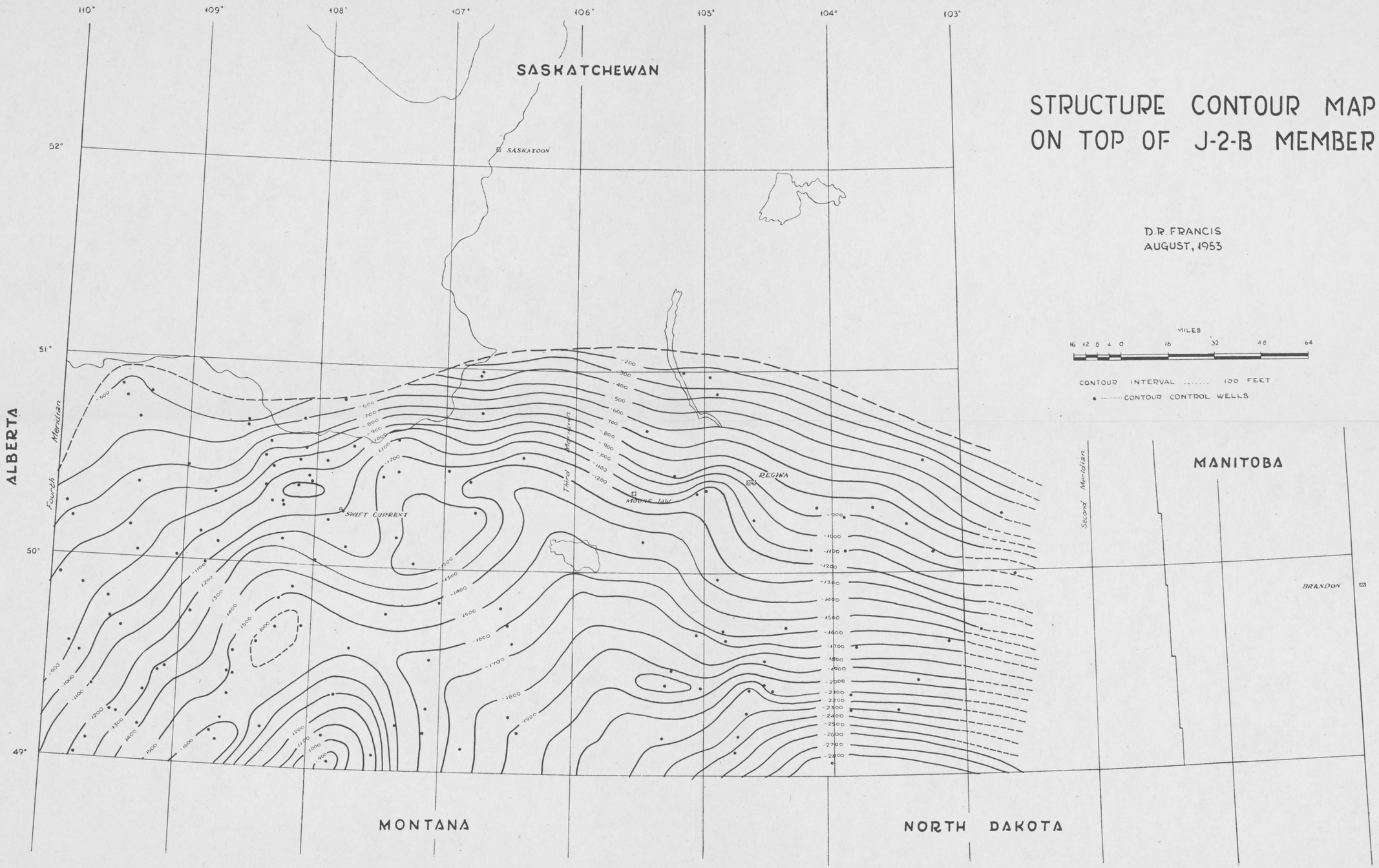

FIGURE IV

PRE-CRETACEOUS PALEOGEOLOGIC MAP

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AUGUST, 1953

LEGEND

JURASSIC
- J-1-A
- J-1-B
- J-1-C
- J-2-A
- J-2-B
- J-3
- J-4-A
- J-4-B

MISSISSIPPIAN AND DEVONIAN

MILES
16 12 8 4 0 16 32 48 64

GEOLOGIC BOUNDARY
" " , POSITION UNCERTAIN
" " , CONCEALED

110° 109° 108° 107° 106° 105° 104° 103°
52° 51° 50° 49°

SASKATCHEWAN
ALBERTA
MANITOBA
MONTANA
NORTH DAKOTA

Fourth Meridian
Meridian
Second Meridian

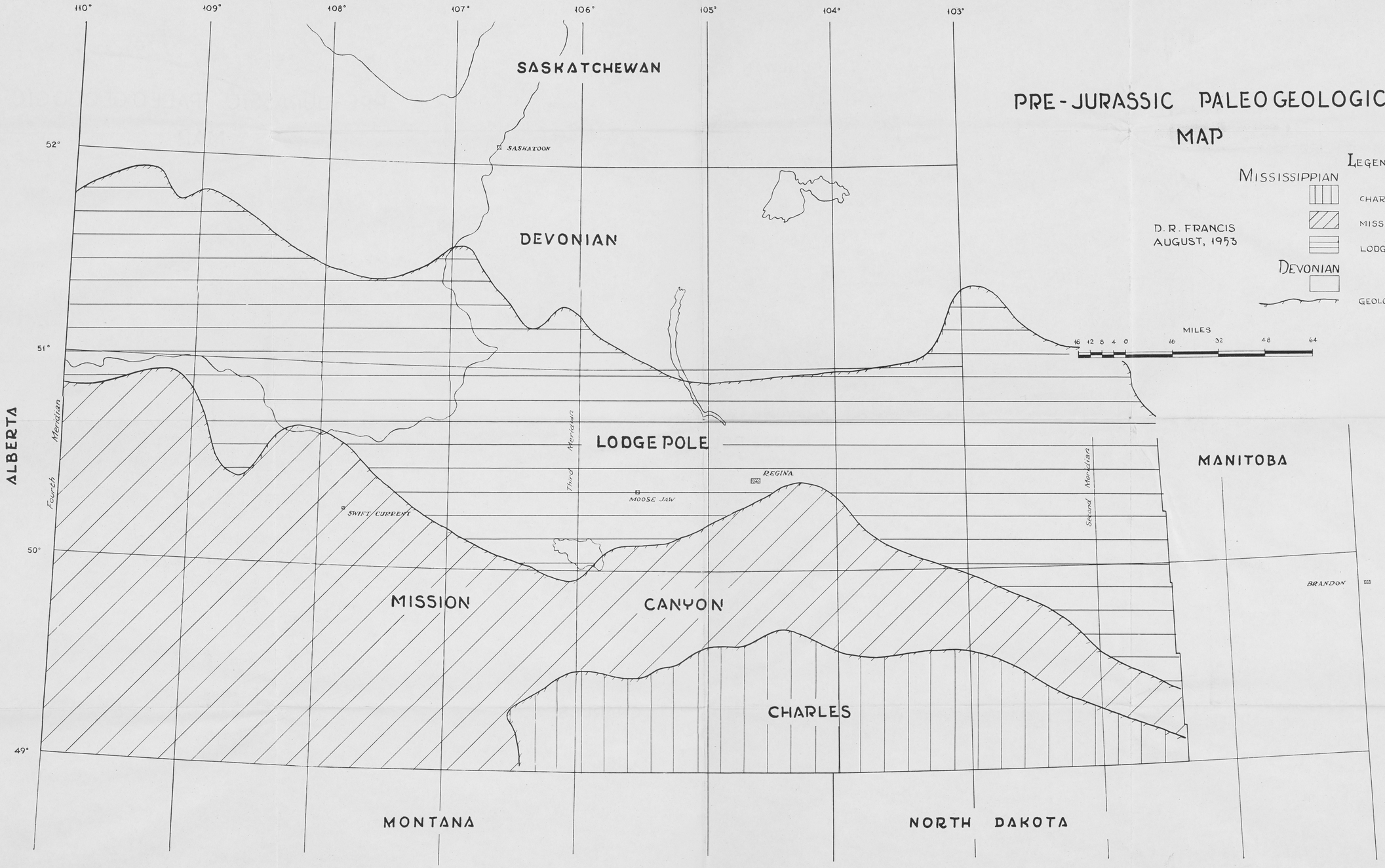
E. SASKATOON
REGINA
MOOSE JAW
SWIFT CURRENT
BRANDON

J-4-B
J-4-A
J-3
J-2-B
J-2-A
J-1-C
J-1-B
J-1-A

FIGURE III

PRE-JURASSIC PALEOGEOLOGIC MAP

D. R. FRANCIS
AUGUST, 1953



Legend

Mississippian

- Charles
- Mission Canyon
- Lodgepole

Devonian

- Geological Bdy.

FIGURE II